Distribution Transformer Failures and Counter Measures

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What is Distribution Transformer Failure

- A simple Internal (or) External fault which obstructs functioning of transformer in network.

- Transformer failure causes black-out of power to the whole area.

- It can also lead to risk of fire and explosions, as the transformers contains substantial quantity of oil.

- Though it looks simple, transformer failure will lead to chain of adverse effects on:
  
  ✓ End User  
  ✓ Distribution Utility Company
Types & Sources of Distribution Transformer Failure

Source -1 External Conditions
- Unauthorized Tapping
- Vandalism
- Oil Leakages
- Faults on LV System
- Lightening Strikes
- External short-circuit

Source -2 Network Operator
- Improper installation
- Improper terminations
- Faulty earth connections
- Bypassing of Protection systems
- Inadequate maintenance
- Prolonged Loading & Unbalancing

Source -3 Manufacturer
- Faulty design
- Quality of Raw Materials
- Poor workmanship
- Improper Mfg. Process
- Improper transportation
- Chances for Under-rated Transformers

Source -4 Procurement Stage
- Improper Technical Specifications
- Improper Inspection Process

Source -2
- Network Operator

Source -3
- Manufacturer

Source -4
- Procurement Stage
Few Examples indicating Improper Installation and Operating Conditions
Unauthorized Tapping (Power Theft)
Improper Termination
Improper Earthing
Bypassing of Protection Systems

Low voltage Terminal Connection provided directly bypassing MCCB
Failure due to Overloading
Arcing Horns - Improper Assembly/Not used
Failures due to Low Oil Level resulted from Oil Leakage

- Kenya Power is the main distributor of electricity in Kenya.
- It has Installed around 59000 Nos distribution transformers in network.
- The approx. failure rate is 7-8%

Source: M/s. KPLC, Kenya.
What Next?

Can we really control these failures?

Counter Measures to overcome Transformer failures
Sources of Failures & Counter Measures

Source: External Conditions

Problem

Solution

Way Forward

- Unauthorized Tapping
- Vandalism
- Oil Leakages
- Faults on LV `System
- Lightening Strikes
- External short-circuit

- Proper Maintenance and Checks to be done.
- Transformer should be manufactured with Anti-Theft arrangements.
- Aluminium Winding may be one of the Solutions to prevent Vandalism

- Training on Installation, Operation & Maintenance
- All Technical measures to be incorporated in Specifications.

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Sources of Failures & Counter Measures

Source: Network Operator

Problem

- Improper installation
- Improper terminations
- Faulty earth connections
- Bypassing of Protection systems
- Inadequate maintenance
- Prolonged Over loading & Unbalancing

Solution

- Know the Right Practices of Installation and Maintenance
- Improve Skill Levels of Operation and Maintenance Staff.

Way Forward

- Training for the field Engineers and Staff.

Some of the counter measures

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Example Measure-1: LV Termination through MCCB for Overload Protection

**Do's:**
Always connect LT terminals through MCCB to protect transformer from overloading & external faults on LT side.

**Don'ts:**
Do not bypass MCCB to avoid transformer tripping in fault conditions.
Example Measure-2: Arcing Horns Assembling Procedures

**Do’s**: Ensure the assembling of top and bottom arcing horns alignment with 85mm gap for 11KV.

**Don'ts**: Never assemble arcing horns in misaligned or missing condition as shown in above photos.
**Example Measure-3: HT Fuse link connecting procedures**

**Do's:**
Always connect HT phase leads through fuse links to avoid transformer failures due to overload or fault currents.

**Don'ts:**
Never Bypass or connect fuse links directly as shown in above figures.
Sources of Failures & Counter Measures

Source: Manufacturer

- Faulty design
- Quality of Raw Materials
- Poor workmanship
- Improper Mfg. Process
- Improper transportation
- Chances for Under-rated Transformers

Solution

- Select Reliable Manufacturer
- Ensure, transformers are manufactured as per the Specifications.

Way Forward

- Technical Evaluation of Manufacturing facilities & processes by a Competent Team
- Proto Testing in 3rd Party independent laboratory.
- Adopt Stringent FAT
- Conduct Post Landing Inspection
Mini Test Set-up (Upto 500kVA)
(Tests: No Load & Load Loss, Impedance Voltage, Winding Resistance and Oil BDV)
(This is an example test setup for explanatory purposes only)
CONCLUSIONS

In Procurement Stage, all the Counter measures should be taken in to Consideration

- Vendor Pre-Qualification Processes
- Product Qualification Processes
- Factory Acceptance Test
- Post Landing Inspection
- Training for field Engineers and Staff
Thank you !